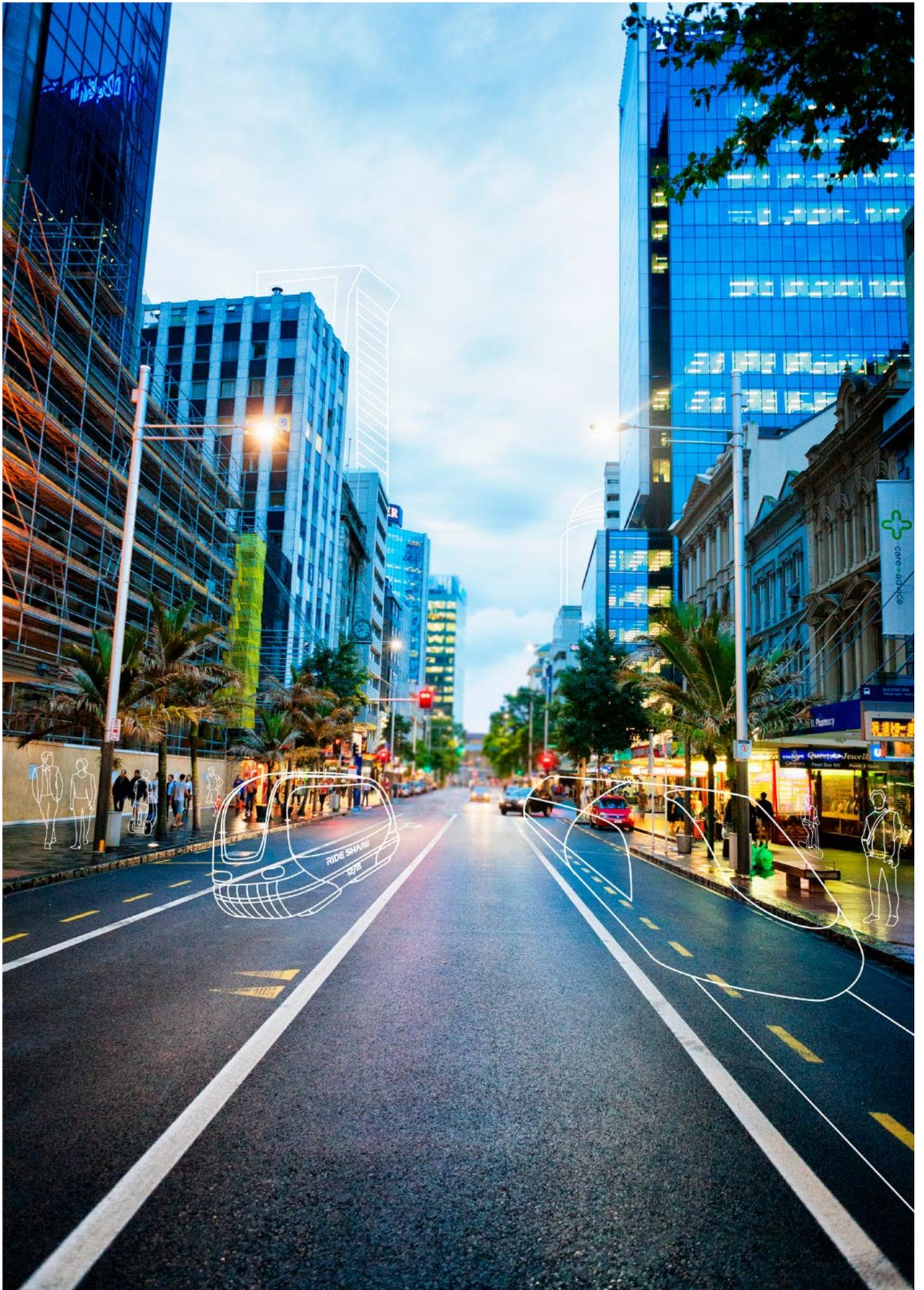


# PUBLIC TRANSPORT 2045

A working paper on urban  
transport in the shared  
mobility era





# FOREWORD

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Ask New Zealanders what public transport means to them today and you'll hear people talking about buses and, in some places, trains and ferries. We're familiar with large vehicles travelling fixed routes, to fixed schedules, stopping at designated pick up and drop off locations along the way. Older people may reminisce about the colourful old buses with tough vinyl seats that they once travelled in as kids, and itching to pull the overhead wire when it was time to disembark. Elderly citizens might also recall gliding through cities in trams, before buses took their place in the 1950s and 1960s.

In many ways, public transport in 2018 isn't remarkably different to thirty years ago. The technologies are smarter—with electronic ticketing, real-time service updates via GPS, on-board wi-fi, and quicker vehicles—but the method is largely the same. Public transport is something primarily planned by local authorities, subsidised by local and central government, and based on large physical infrastructure. While public transport patronage has increased in recent decades, most New Zealanders still choose to travel by the dominant alternative—private cars.

Fast forward thirty years into the future and our urban transport systems could look remarkably different. Private car ownership may no longer be common among most households because there are more attractive alternatives for urban travel. Fleets of shared autonomous cars and mini-buses may pick people up on demand. Trains, light rail, and rapid buses travelling on dedicated right-of-ways could move many people into, and around, the heart of our cities. People could choose to travel to/from rapid transit stations by walking, biking, taking a private self-driving shuttle, or sharing a ride with others. The roar of petrol and diesel motors could have largely been superseded by the hum of electric vehicles. The possibility of air taxis operating in designated areas is also very real.

This working paper explores these kinds of possibilities in four different scenarios for public transport in 2045. These future scenarios serve a useful role as transport infrastructure lasts for many decades. Some of today's investments will shape over decades how people move, how cities grow, how easy it is for people to access places, and how we experience urban life on a daily basis. While infrastructure changes slowly, technologies often change rapidly. We need to consider the possible, and probable, impacts of these changes so that we can invest in transport infrastructure and services that benefit people now and well into the future.

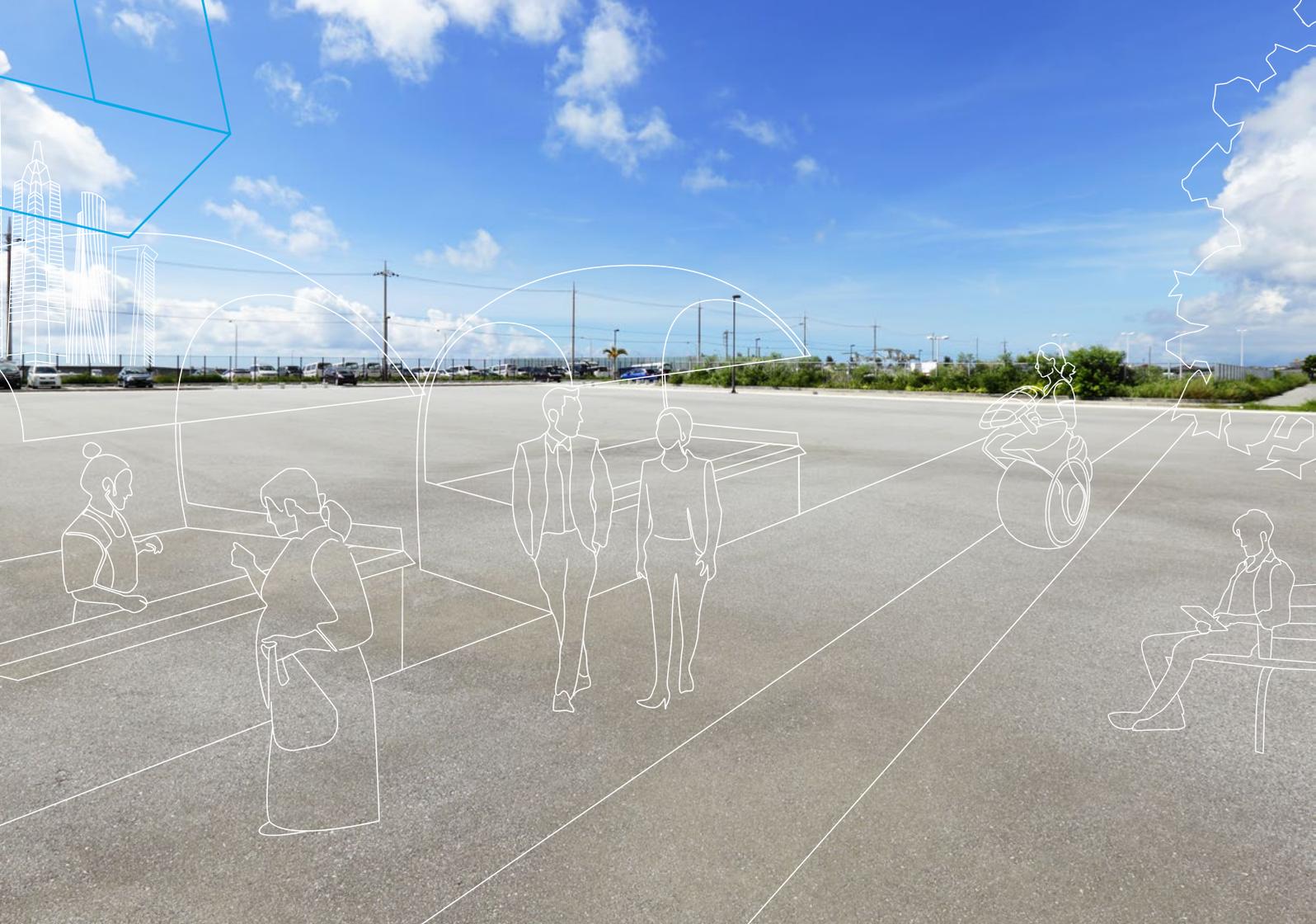
What this working paper tells us is that as our cities grow and new transport technologies and services open up, so do new opportunities and risks. High quality public transport systems will become increasingly important to improve urban liveability and people's wellbeing. Dedicated corridors for high occupancy vehicles will be crucial to make travel by public transport quick, convenient and reliable, and to avoid ever-increasing congestion.

Today's decisions and investments will shape our cities of the future. Our approach to how we plan and use public transport will need to evolve and I'm excited by the opportunities we see before us. Public transport could make our cities better places to live, while making mobility cheaper, safer, more accessible, and better for our environment. But we can't wait thirty years for that to happen. We need to envision a desirable future, and start to navigate our way through the transition.

*P. Mersi*

**Peter Mersi**  
Chief Executive, Ministry of Transport





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# KEY MESSAGES

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**This working paper explores the long-term future of public transport in New Zealand’s cities, in a world where transport technologies and services are rapidly evolving. It is intended to provoke dialogue, and to challenge the assumptions that public transport in thirty years’ time will look only slightly different from what we are familiar with today—or alternatively, that it has to look completely different in every way.**

Internationally, a shift is happening in transport. Ride-sharing and vehicle-sharing are on the rise. Shared bikes and scooters are rapidly arriving on city streets. Car companies are competing to sell mobility, instead of just vehicles. There is intense competition to develop fleets of shared autonomous vehicles. We could be entering a ‘shared mobility’ era in which people increasingly prefer to share vehicles and rides, instead of owning and driving private cars.

We need to consider how these changes could affect our transport system, people’s wellbeing, and the liveability of our cities. New technologies and services always offer both benefits and risks. For example, fleets of self-driving vehicles could make travel more convenient, safer, and more accessible for many people, but could also generate increasing traffic, congestion, and urban sprawl. Ride-sharing services make it easier for people to get to/from rapid transit stations, but can also attract people away from using public transport.

There is high uncertainty about when some technologies could arrive, or how eager or resistant New Zealanders will be to innovations. That is why we need to explore different possible scenarios. The four future scenarios in this working paper were based on interviews with approximately

fifty far-thinking transport experts. These scenarios do not describe what the future will be like. Instead, they envision how automation and urbanisation could affect urban transport in the future. We used these scenarios to explore implications for public transport and our cities.

Our main message from this working paper is that public transport needs to be at the core of a shared mobility future. Otherwise, we risk facing higher levels of motorised traffic and congestion in our cities.

In high density urban areas, we envisage a greater need for rapid transit systems—high frequency buses, light rail, and trains travelling on dedicated corridors—to move large volumes of people quickly, safely, and cleanly.

There are opportunities to connect rapid transit services with other parts of a shared mobility system. People could travel the first and last legs to/from public transport stations by shared shuttles, bikes, and scooters, with people seamlessly planning and paying for travel via personalised mobility apps. High quality infrastructure for walking and cycling to/from public transport stations could encourage more active travel, benefiting public health.

In low density suburban areas, we envisage demand-responsive buses and shuttles replacing many scheduled bus services and routes. These could lead to better services for passengers, and a more efficient system.

Although this working paper focuses on ways that new technologies and services could affect transport and our cities, an underlying message is that our future should not simply be technology-led. We need to be discerning about new technologies, and shape them in ways that improve urban liveability and people’s wellbeing far into the future.



## MORE INFORMATION

Additional reports and research related to this working paper are available at [www.transport.govt.nz](http://www.transport.govt.nz), including:

- > background research on definitions and frameworks
- > historical trends and drivers of public transport
- > detailed findings of interviews with 50 public transport stakeholders.



# INTRODUCTION

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**How could New Zealanders be moving around our cities thirty years from now? Will public transport systems look similar to today, with more advanced technologies, or could they evolve into something remarkably different?**

This working paper explores how emerging transport technologies and services could affect public transport, urban travel, and life in New Zealand's cities.

The Ministry of Transport initiated this project to deepen understanding of the profound challenges and opportunities that our transport system could face in the next few decades. We can already see the growing influence on transport of robotics and machine learning [e.g. increasingly automated vehicles], digital technologies [e.g. connected vehicles and infrastructure], new business models [e.g. for vehicle-sharing and ride-sharing], and innovative trip planning and payment systems [e.g. via smartphones].

These technologies and services will have wide-ranging impacts, yet the implications for public transport are uncertain. We could see far greater sharing of transport services, and/or an even greater emphasis on people travelling alone in vehicles. This working paper grapples with these uncertainties and explores different views of the future. It includes:

- > **views on public transport:** a summary of prevailing views on the future of public transport in New Zealand, based on interviews with transport experts and stakeholders
- > **alternative future scenarios:** four possible futures for public transport in New Zealand's cities to the year 2045, based on differing degrees of automation and urban density
- > **insights from the futures:** potential implications for public transport and urban travel that became apparent through the research and future scenarios.

## THE ROLE OF THIS WORKING PAPER

The Ministry of Transport is the government's lead advisor on transport matters. Our role includes providing advice on transport choices, and on how transport can best contribute to wellbeing and liveability for all New Zealanders now and into the longer term.

This document is part of the Ministry's Strategic Policy Programme, which recognises that transport investments leave long legacies. They pay back over decades, so we need to have the long term in mind when we invest. By exploring implications of different future scenarios, we can make more well-informed decisions and take early choices that shape new technologies to support the communities we want and outcomes we value. The Ministry has previously developed scenarios for the future of transport demand and regulations.

This working paper aims to push the boundaries of existing thinking to explore alternative futures. It is not limited to current government policy, as the timeframe is set almost thirty years in the future. Thirty years is also an indicative date. Some of the changes explored in the scenarios might not exist for fifty years, or may not occur at all.

The scenarios in this document are tools to imagine possible paths into the future. They explore potential implications and side-effects of different social choices and developments. We hope that these scenarios encourage further dialogue on how we should respond to the challenges and opportunities of new technologies, and the role of public/shared transport in improving wellbeing and urban liveability. This work and the discussion it provokes will help to inform transport planning and future choices.

## CHANGES COMING, READY OR NOT:

### THREE TRENDS THAT WILL AFFECT PUBLIC TRANSPORT IN THE NEXT TEN YEARS



#### VEHICLES ARE BECOMING INCREASINGLY AUTOMATED

Trains, buses, ferries, and cars are becoming increasingly capable of assisting, and replacing, human drivers. All major car manufacturers are investing heavily in automation. Companies that are aiming to have fleets of autonomous cars on public roads by 2021 [at 'level four' automation, with human input still required in some situations] include Audi, Baidu, Bosch, BMW, Daimler, Faraday Future, Ford, General Motors, Google, Honda, Hyundai, LeEco, Nissan, PSA Group, Tesla, Toyota, Uber, and Volvo.

Global tests of autonomous taxi services are already underway on public roads, after starting in Singapore [by nuTonomy] and Pittsburgh [by Uber] in 2016. These services currently require a human to monitor driving and take over controls if need be.

It is uncertain when vehicles with 'level five' automation [requiring absolutely no human intervention for driving to any location where it is legal to drive] will begin operating on public roads.



#### MOBILITY AS A SERVICE PLATFORMS ARE CHANGING HOW PEOPLE PLAN AND PAY FOR TRAVEL

Mobility as a Service [MaaS] platforms incorporate every available transport mode, including bike-sharing, car-sharing, ride-hailing, and existing forms of public transport, in a transport planning and payment app.

Proponents envision subscription plans across transport modes, as an attractive alternative to private vehicle ownership and use.

Approximately a dozen of these systems currently exist, mostly in Europe. For example, the Whim service in Helsinki models on-demand usage and aims to offer subscribers monthly unlimited mobility plans across transport modes for less than the total cost of car ownership. The New Zealand Transport Agency began piloting MaaS apps for New Zealand in 2017 at Queenstown and Auckland airports.



## CAR MAKERS ARE RE-ORIENTING THEIR BUSINESS MODELS

All major car makers are re-aligning their business models to sell mobility as a service, instead of just vehicles. For example:

- > BMW launched the 'ReachNow' mobility service in Seattle
- > Volkswagen invested US\$300 million in Gett, a German mobility service provider
- > Fiat Chrysler partnered with Alphabet/Google to launch an autonomous ride-sharing service
- > General Motors invested US\$500 million in Lyft to develop a fleet of autonomous electric taxis
- > Tesla has a master plan for a connected fleet of autonomous vehicles, with owners able to make their vehicles available for use by others on demand.

## GLOSSARY

**Carpooling:** A form of ride-sharing in which people agree to travel together, often to/from work or education, in vehicles owned by the carpool members.

**Congestion pricing:** A method used to manage, reduce, or shift traffic by charging road users a fee during peak travel times, and/or in designated areas. The fee may vary by the time of day and day of the week.

**Mobility as a Service (MaaS) platforms:** A digital system that connects travellers with transport options, such as public transport, taxis, car-sharing, ride-sharing, and bike-sharing services. Users identify where they want to go via their smartphones or other web-connected devices, and then choose a preferred option from competing providers. Travellers can pay for individual trips or a combination of services, or (in some cases) subscribe to a package of mobility services.

**Public transport:** A system for taking people from one place to another via vehicles such as buses, trains, and ferries, that usually operate on fixed routes at scheduled times or frequencies.

**Rapid transit:** A high capacity and high frequency form of urban public transport, with vehicles such as trains and buses that usually run on dedicated corridors or right-of-ways.

**Ride-sharing:** Two or more people sharing a trip in the same vehicle, with the passengers travelling for free or for a fee. This includes carpooling and taxi-like services booked via a website or app.

**Shared transport:** Any form of transport that citizens can use to move from one place to another without privately owning the vehicles used.

**Value capture:** A type of public financing that recovers some or all of the value that public infrastructure generates for private landowners. Transport infrastructure investments often increase adjacent land values. Some of this value can be 'captured' by taxing or charging the direct beneficiaries of these investments.

**Vehicle-sharing:** Using a vehicle for personal purposes that is not privately owned, for a short duration of time. The vehicle may be rented via a service provider, or owned and used collectively by a peer group. A wide variety of vehicles can be shared, including cars, bikes, and scooters.

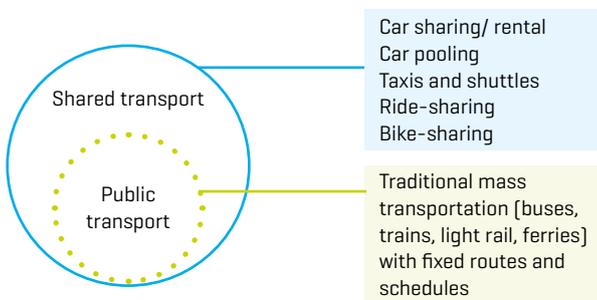
# VIEWS ON PUBLIC TRANSPORT



## WHAT IS PUBLIC TRANSPORT?

How people think about public transport is shifting. The term ‘public transport’ has historically been associated with trains, buses, and ferries that take people from one place to another on fixed routes, at regular times. It has usually not been associated with other forms of shared travel such as taxis, shuttles, ride-sharing, or bike-sharing. Yet all of these services share some common characteristics. They are all services that people share access to, and they all require a service provider to invest in a physical/digital infrastructure network.

The boundaries between ‘public’, ‘private’, and ‘shared’ transport are already blurry, and will blur further as technologies and services evolve. For example, if fleets of rentable autonomous cars become widely available in cities, and they are cheap for people to use for trips on-demand, could they be considered a form of public transport in the future? Would it make any difference if they were owned by government, social enterprises, individuals, or corporations?



Over the next thirty years we are likely to see ongoing shifts in how people think about and use public transport. This working paper takes a broad approach. It explores the future of traditional public transport services as part of a larger shared transport system [see diagram above].

To keep a manageable scope, it focuses on urban transport systems. It does not consider future forms of travel between regions.

## WHY IS PUBLIC TRANSPORT IMPORTANT?

Public transport provides many social, economic, and environmental benefits, which is why government supports it. Local government has provided and/or funded public transport services in New Zealand for over a century. Central government first started investing in public transport services in the 1970s, for three main reasons:

- > to ensure access to social and economic opportunities (e.g. access to jobs, shops, and local amenities) for those who do not drive or cannot afford their own private motorised vehicle,
- > to reduce the environmental harms caused by transport (e.g. air pollutants), and
- > to manage congestion.<sup>1</sup>

There is also growing recognition of the positive role that public transport can play in:

- > improving urban form and liveability, and
- > benefiting health and wellbeing.

Over 85 percent of New Zealanders live in urban areas. As population and growth pressures continue to rise in our cities, urban liveability will become ever more important. The quality of urban environments affects people’s physical and mental health. It also affects economic prosperity as highly liveable cities attract people and business activity.

Internationally, high liveability in a transport context is associated with places where people can easily access destinations by public transport, walking, and cycling.<sup>2</sup> Public transport benefits urban liveability in two major ways. Firstly, it enables more efficient use of limited urban space, so that this space can be used for high value purposes. Compared to private vehicles, trains and buses require much less urban space to move high volumes of people. When people use public transport instead of private cars, it also reduces the amount of space needed for car parking.

1. These reasons were established by a central government committee of inquiry in 1969. This committee issued the Carter report in 1970, which recommended central government subsidise and encourage public transport.

2. For example see Rundel J, Lowe M, Hooper P, Roberts R, Rozek J, Higgs C, Giles-Corti B (2017), *Creating liveable cities in Australia: Mapping urban policy implementation and evidence-based national liveability indicators*. Centre for Urban Research, RMIT University, Melbourne.

Secondly, transport shapes urban form. Rapid transit public transport systems—with high capacity, high frequency services—can play a powerful role in attracting developments and increasing urban density. Intensification tends to occur around transport corridors and transit hubs, as people value living in areas with easy access to other parts of the city.

Highly liveable places support positive health and wellbeing. For example, people tend to find neighbourhoods more appealing and safer to be in when streets are not dominated by high volumes of fast-moving motorised traffic. Streets with lower traffic volumes encourage more community interactions.<sup>3</sup> Public transport is also the safest form of travel in New Zealand, and people who use public transport tend to be more physically active than people who always travel by private vehicle.<sup>4</sup>

## A SNAPSHOT OF PUBLIC TRANSPORT TODAY

**In 2018, travel in New Zealand’s towns and cities is dominated by private cars. Over 90% of households own at least one car, and most own two or three.**

Travel by public transport represents less than five percent of trips. Even for short trips (2km or less), people mostly use cars instead of other options, such as walking or cycling. Most New Zealanders walk for less than one hour per week.

Buses are the most common vehicle for public transport in our cities. Approximately three quarters of public transport trips in New Zealand are by bus. Trains also play a significant role in Auckland and Wellington. No vehicles are fully automated. Public transport schedules are almost entirely planned in advance, with vehicles following fixed routes.

Taxis and ride-share operators only play a marginal role in moving people. Travel patterns show regular morning and afternoon peaks on weekdays, with congestion rising in these periods. The diagrams on the following page provide an overview of transport in 2018.



Photo by: 家禎 張 Attribution-NoDerivs 2.0 Generic [CC BY-ND 2.0]. New Plymouth Central

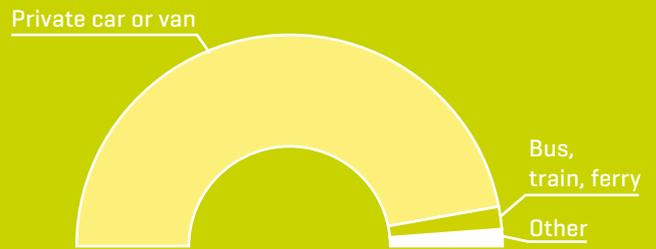
3. Ferrer HB, Cooper A and Audrey S (2018), 'Associations of mode of travel to work with physical activity, and individual, interpersonal, organisational, and environmental characteristics', in *Journal of Transport & Health* (in press).
4. Wiki J, Kingham S and Banwell K (2018), 'Re-working Appleyard in a low density environment: An exploration of the impacts of motorised traffic volume on street livability in Christchurch, New Zealand', in *World Transport Policy and Practice*, Volume 24, 1, 60-68.

# TRANSPORT OVERVIEW 2018

## Fully automated vehicles [% of fleet]

Rail	0
Buses	0
Cars	0
Ferries	0

## Total travel in cities [annual km by vehicles]



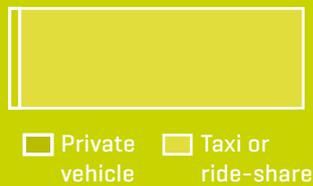
## Household car ownership



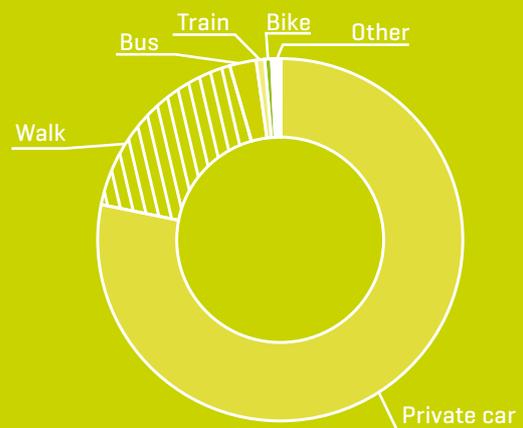
## Peak travel times: Wednesdays



## How people use cars [trips in cities]



## 2km trips: Most common modes



## Routing and scheduling



## 10km trip into large metropolitan areas: Typical shared transport profile at 8am Mondays



NOTE: These are based on generalised data across New Zealand cities.

# EXPERTS' VIEWS OF THE FUTURE

The future of New Zealand's public transport system will be shaped by many factors including technologies, social preferences, business models, public and private investments, environmental impacts, and politics. It will also be shaped by people's mindsets—how people think about, and imagine, the future.

To develop a clearer picture of how people currently think about the future of public transport in New Zealand, the Ministry of Transport interviewed 50 public transport experts and stakeholders from New Zealand and further afield. These people included central and local government transport advisors, public transport operators, community groups, vehicle-sharing and ride-sharing service providers, and academics.

The findings from those interviews are summarised in Table 1 [see following page], with more details below.

## THE HIGH LEVEL EXPERT VIEW OF THE FUTURE

The prevailing view among people we interviewed is that public transport in 2045 will still involve features that are recognisable today. There will still be buses, trains, taxis and private cars. How people use these vehicles, and the proportions of travel by different vehicles, may be very different though. Private car use is likely to decline, for example, as other convenient options such as ride-sharing and car-sharing become more popular.

Public transport vehicles may become fully autonomous, with trains likely to be the first mode to convert. Vehicle control systems may become either more or less centralised as vehicles become more automated. Propulsion systems may also be very

different from today. Fossil fuels are likely to be phased out in favour of electric vehicles and other alternative fuels.

Fewer public transport services are likely to operate on fixed routes or schedules. Instead, they will respond flexibly according to demand. Passengers will seldom use timetables, either because high frequency services operating on fixed corridors will be frequent enough so that people will just show up and a service will arrive, or because low frequency services will be replaced by on-demand alternatives that people will book when required.

Pricing will respond to both the level of demand and the type of travel services provided. It will be used as a tool by public transport operators and users to optimise efficiency and manage congestion. Payment systems will be integrated and seamless, making flexible pricing systems pain-free for users.

An increasingly diverse group of people are expected to use public transport, and these people's expectations will be higher than those of public transport users today. They will expect seamless travel between highly integrated travel modes. Operators are also expected to offer more differentiated services, with travellers paying for attributes [e.g. extra space, comfort, or entertainment options] that they value.

The people we spoke with also expect transport systems to be operated by a broad range of providers from the government, private, and community sectors. Central government is seen as being an enabler rather than a provider.



**Table 1:**  
**How transport stakeholders currently view the future**

<b>Consensus views</b>		
●	Transport system	Overall, legacy effects will largely constrain the pace of change; there will still be buses, trains, taxis.
●	Routing and scheduling	Only high frequency services will use fixed routes; others will be demand-responsive.
●	On-board experience	Public transport vehicles will be more comfortable and travel times will be shorter.
●	Users	A more diverse group of people will be using public transport.
●	Stakeholders	Public transport operations will be delivered by a broader range of providers.
<b>Majority views</b>		
●	Autonomous vehicles	Rail services will be fully autonomous; other services may also use autonomous vehicles.
●	Car ownership	Car ownership will decline, though some car enthusiasts will want to own and drive a vehicle.
●	Timetables	Timetables will not exist as they do today; they will be replaced by real-time scheduling information.
●	Payment	Pricing will be flexible; users will pay for a 'bundle' as they do now in the telecommunications sector.
<b>Mixed views</b>		
●	Transport topology	Point-to-point services will dominate in low density areas; hub-and-spoke in high density areas.
●	System propulsion	There will be a shift away from fossil fuels, most likely towards electric vehicles.
●	Vehicle size	Increased autonomy and demand-responsiveness will lead to smaller public transport vehicles.
●	Passenger expectations	Passengers will have higher expectations of the quality of public transport.
●	Government	Government will play the role of enabler and watchdog rather than that of provider.
●	Technology	Technology will be the strongest influence in the transport sector's development.
●	Density and demand	High density areas will see the majority of growth and development in public transport.
<b>Known unknowns</b>		
●	Segregation	Manual and autonomous vehicles might be segregated during the transition to full automation.
●	System control	Autonomous vehicles could be co-ordinated together via a 'big brain', promoting network efficiency.

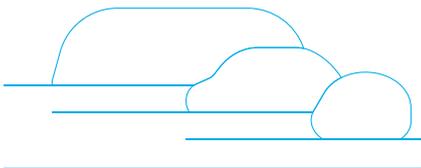
**Themes**

- Overall transport system observations
- Stakeholders and governance
- Public transport system perspectives
- Broader factors
- User perspectives

**MORE INFORMATION**

More details on the interview questions asked and a comprehensive summary of themes are available in a separate background paper for this working paper at [www.transport.govt.nz](http://www.transport.govt.nz).

## DELVING MORE DEEPLY INTO THE EXPERTS' VIEWS

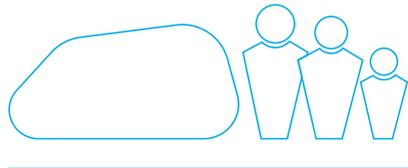


### Infrastructure

New Zealand has invested, and continues to invest, heavily in its transport infrastructure. Given this, the majority of people we spoke with commented that we will still be using a lot of existing infrastructure in thirty years' time.

The technologies used on our roads and railways will differ, leading to more efficient use of our transport system. Infrastructure will also need to be adapted, for example with embedded digital sensors, to enable new technologies such as connected and autonomous vehicles to operate.

Interviewees highlighted the potential for public transport to enable more efficient travel by providing separate lanes for buses, cars and bikes. However, some questioned whether segregation will become widespread in New Zealand's transport system, due to the costs and difficulties of retrofitting existing roads.

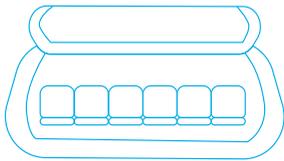


### Car ownership and the public transport network

A combination of new and improved mobility options is expected to diminish the need for car ownership. The majority of interviewees did not expect car ownership to disappear completely though. Most households are unlikely to need two or three vehicles in the future, but may retain one.

As technologies continue to develop, traditional forms of public transport are expected to become more attractive. Driver automation will reduce fare levels. Technologies will be used to optimise the use of existing infrastructure and to boost efficiency. More flexible and on-demand routing systems are expected to contribute to highly reliable systems that travellers trust to get from point A to point B.

Mobility as a Service [MaaS], car-sharing and ride-sharing schemes were regarded as the driving force behind lower car ownership levels in New Zealand. Technology will enable the ongoing development and spread of these mobility options. Their convenience will increase to such a level that the relative advantages of owning a private vehicle will reduce.



### Automation

The transition to fully autonomous vehicles is expected to begin with public transport, such as trains and buses. It will then move to taxis, passenger transport, and corporate fleets. Most interviewees thought that autonomous vehicles will be present by 2045, but not necessarily prevalent.

Interviewees gave various reasons for the rise in autonomous vehicles, including their economic appeal, and the increasing status of these vehicles. For public transport in particular there will be major economic incentives to adopt these vehicles, as human drivers currently represent a large share of operating costs. The nature of mass transit routing is also expected to make automation relatively easy to implement [compared to private vehicles].

Expected barriers to a fully autonomous fleet include New Zealand's slow vehicle turnover, the potential cost of the vehicles, and public attitudes/perceptions. If the public is not ready to adopt this technology, then it is unlikely to happen at any great pace.

Some people also offered an alternative view on public acceptability. New Zealand has a high technology uptake rate, as people are attracted by new technologies and gadgets. Because of this, some interviewees regarded public perception as a low barrier. Once New Zealanders get over the first hurdle of getting into a fully automated car, they are expected to quickly become at ease with the technology.



### Expectations for higher quality services and experiences

Passenger expectations are likely to change, with growing demands for more accessible, more reliable, and more comfortable public transport services. Passengers will expect rides to be available when they need them. Some passengers may want services to provide them with entertainment or the means to work. Operators are expected to provide these aspects, although some amenities could be offered for a premium price.

Payment and pricing systems are set to change, with interviewees expecting an easier experience overall. Integrated payment methods [most likely digital] will enable customers to make a multi-modal journey on just one fare, and with just one payment method. Fares themselves are also expected to be different, adjusting to fit both demand and supply. If more transport options are required, the cost to users will increase. To flatten out congestion at peak hours, cheaper travel would be possible during off-peak hours. With an integrated system pricing methodologies could be complex, so long as they are transparent.

Higher quality services [with greater frequency, reliability, and comfort] are also expected to attract a more diverse group of people to use public transport.

# ALTERNATIVE FUTURE SCENARIOS

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# OVERVIEW OF THE SCENARIOS

The following scenarios explore four possible futures for public/shared transport in New Zealand's cities to the year 2045.

These scenarios reflect many of the themes discussed by public transport experts in the previous section. They also stretch current thinking. They have been written to provoke further dialogue, and to challenge assumptions that our future transport system will simply be a slightly different form of what we see today.

## WHAT THE SCENARIOS EXPLORE

The scenarios explore how public/shared transport could be affected by two major drivers of change: *vehicle automation* and *urban density*.

### VEHICLE AUTOMATION

Automated technologies are rapidly evolving and could have a profound impact on our transport system. If vehicles no longer require a human driver then this could fundamentally shift the costs of transport services and the preferences of people using these services. All motorised vehicles are likely to be equipped with increasingly automated functions, but it is unclear whether all vehicles could become fully automated (driving autonomously) by 2045. It is also unclear whether automated vehicles could operate independently, or as part of integrated networks. The degree of automation will depend on technological capabilities, social norms, benefits, costs, and regulations.

The scenarios explore two alternative paths to the future, ranging from 'partial' to 'full' automation.

Automated vehicles: A range of possibilities for 2045



In **partially automated** scenarios, vehicles have many automated features, but the majority require a driver for many functions. Cars may be able to park, change lanes, and adjust speed automatically, but they are unable (or not permitted) to drive themselves from point to point without any human intervention.

In **fully automated** scenarios, all vehicles can operate without a human driver, at least in urban settings. They are able to interact with infrastructure, people, and other vehicles successfully and safely on their own. Some vehicles may retain some form of manual override, for passengers' peace of mind.

### URBAN DENSITY

Urban population density has a strong influence on public/shared transport services. Public transport is usually more financially viable in high density cities, with more people travelling on shared routes. It is unclear how much urban density could increase or decrease in New Zealand's towns and cities over the next thirty years. The degree of density will depend on many factors, including planning regulations, property prices, living costs, social preferences, population growth, and the quality of urban design.

By 2045, New Zealand's cities will not become as densely populated as many existing global cities such as Singapore, Hong Kong, New York, or Mumbai. 'High density' in a New Zealand setting has a different meaning, relative to what we see today.

Urban density: A range of possibilities for 2045

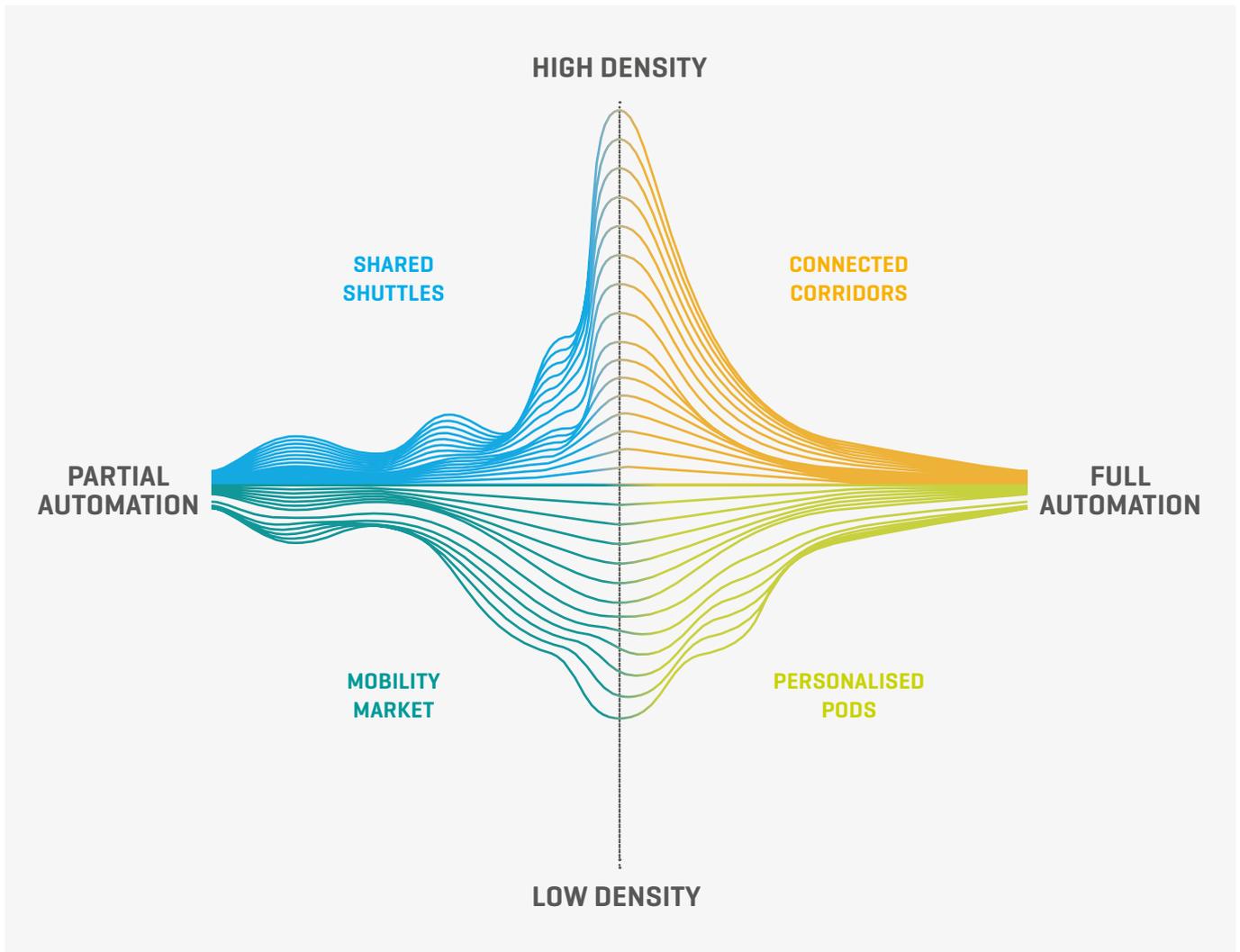


In **low density** scenarios, urban settlements spread outwards more than they grow upwards. Density still increases compared to 2016, but in most places density is similar to what we currently see in places like Hamilton or Christchurch.

In **high density** scenarios, urban settlements grow upwards more than outwards. They reach a similar density to inner-city Auckland or Wellington today (with further intensification in those places), with many compact neighbourhoods.

# THE FOUR SCENARIOS

The scenarios explore four different possible futures by combining the uncertainties we face around transport automation (partial or full automation by 2045) and urban density (high/low). The scenarios are summarised in the following diagram.



## SHARED SHUTTLES

Choices abound for those willing to share. Ride-sharing and mini bus services shuttle many people around town, when they aren't walking, biking, and scooting around compact urban centres.

## MOBILITY MARKET

Cars rule, for both personal travel and ride-sharing. Travellers purchase customised 'mobility packages' with prepaid allowances to use on different travel modes and services, including bus and rail options.

## CONNECTED CORRIDORS

Intelligent networks of automated buses, rail services, and cars rapidly move people on major transport corridors. Travellers are automatically guided along routes and services by their all-knowing personalised travel apps.

## PERSONALISED PODS

Fleets of autonomous 'pods' have replaced all bus services and most privately owned cars. Pods offer affordable on-demand travel from point to point, with people using pods privately or sharing rides for cheaper trips.



## EACH SCENARIO INCLUDES:

- > an **observation on city life** from an urban resident in 2045
- > **how we could get to this future**, with transitions in transport over the next thirty years
- > a summary of **how people travel** in the future
- > a **visual overview** of speculative transport data in 2045.

## WHAT THE SCENARIOS SHARE IN COMMON

In all four scenarios we assume that urban areas will continue to grow, with pressures to affordably accommodate growing populations. How this plays out in each scenario differs, depending on the density of urban developments and how technologies are used.

We also assume that travellers will continue to value comfort, convenience, safety, price, reliability, timeliness, ease of access, and quality experiences when choosing how to travel. The relative cost [in time and money] of using private cars versus public/shared transport will also remain influential.

## WHAT THESE SCENARIOS ARE NOT

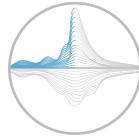
None of these scenarios describe preferred worlds or systems planned today. They are plausible descriptions of possible futures, rather than predictions.

The scenarios have not been written with any particular city/town in mind. This is to make them applicable to different audiences and places. Some features of each scenario may be more meaningful in some settings than others [e.g. rail services may play a significant role in some cities, but not exist in others]. New Zealand's cities already have their own unique public transport systems, although they share many characteristics. The main concepts and ideas contained in each scenario could be applied to any of our major metropolitan areas.

The scenarios are not based on modelled data. The visual data and graphs included with each scenario are only intended to convey an impression of how the scenarios differ from one another and the situation today. The data is highly speculative, based on the drivers at play.

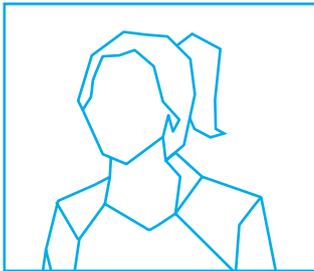
The rest of this section explores each of the scenarios.

# SHARED SHUTTLES SCENARIO 2045



AUTOMATION: ●●○○○ Partial      DENSITY: **HIGH**

SOCIAL MOOD: Collaborative    Enterprising    Picky



## Observations on city life by ANIKA PEETWAY

**Occupation:**

Vertical farm food technician

**Age:**

29 [born 2016]

## CITY LIFE

“Our city’s got a heart. It’s pulsating. We love the tree-lined boulevards with round tables that spill from bars and cafés. The tables are a sweet place to pause and watch people: the buskers, busy office workers, students milling outside NutriParlours, fruit peddlers, joggers with dogs wearing colour co-ordinated suits, and tourists from the airships.

It’s much more peaceful now that only electric vehicles are allowed into the centre. The streets reverberate with thousands of shoes padding the pavement, shouts, laughter, bike bells, and those annoying animated ads that hover in mid-air.

Travelling through town’s a breeze. Just head to a side street and hail a mini bus or ride-share. The purple vehicles are state owned. The stripy ones are social enterprises. All the other colours are run by corporations or individuals. Take your pick. If you’re rushed, or not fussed, just take any one. The same number of credits roll out of your account when you take a standard service, depending on the time and distance. You’ll only pay extra if you go premium: like those buses with the adaptive seats that self-adjust to your body’s shape.

If you’re keen on keeping fit, jump on a shared bike or scooter [the same colour codes apply]. They’re super cheap to hire. Just touch the handlebars to sync accounts and you’re away.

Living close to the centre isn’t for everyone, of course. Apartments and townhouses get cluttered if you’re not keen on sharing lots of stuff. It’s noisy too, especially when the road outside your window is being reconfigured for a market during lunchtimes and on weekends.

There’s always the outer ‘burbs for those who crave more space, or can’t afford something central. Travelling into or across town is quick if you live near a rapid bus station, or one of the rail hubs. It’s a bit slower on the mini buses. As for driving your own car into the city, forget about it. Of course there’s nothing stopping you, if you’re loaded. Most of the time it’s simply not worth the time or money. But based on the streams of single occupant cars in the low priority lanes, many people are willing to pay for the privilege.

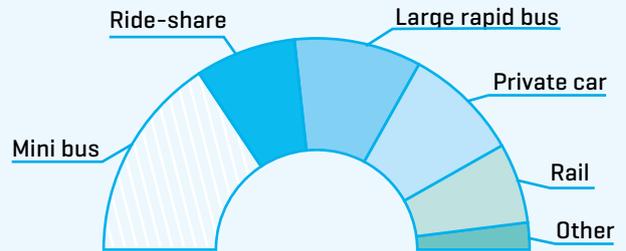
Our city bursts with colour. We’d never live anywhere else. Other people sometimes test our patience, with their pushiness, occasional outbursts, and weird idiosyncrasies. But we’re learning to tolerate each other. It’s all of us, living, working, and breathing together, who give our city its heart.”

# OVERVIEW

**Fully automated vehicles (% of fleet)**



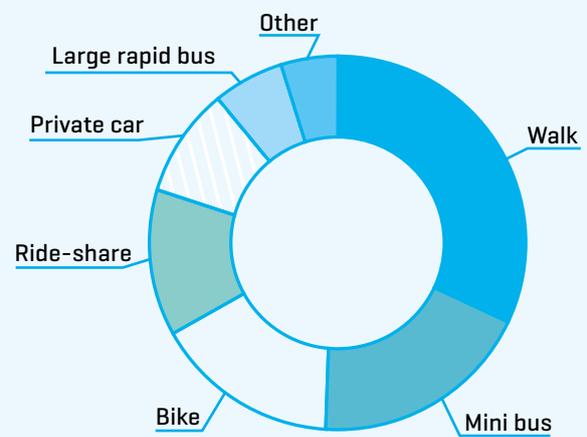
**Total travel in cities (annual km by vehicles)**



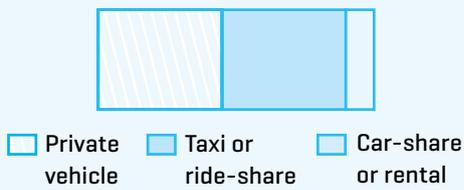
**Household car ownership**



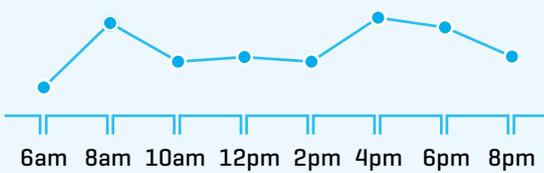
**2km trips: Most common modes**



**How people use cars (trips in cities)**



**Peak travel times: Wednesdays**

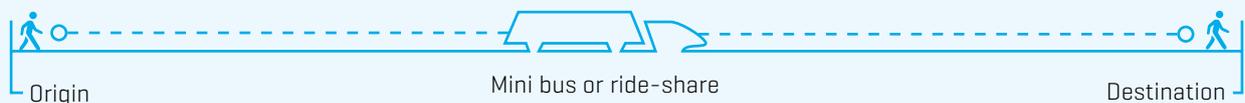


**Routing and scheduling**

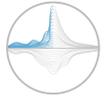


**10km trip into large metropolitan areas:**

Typical shared transport profile at 8am Mondays



NOTE: These are not forecasts. See comments on page 21.



## HOW WE GOT TO THE SHARED SHUTTLES SCENARIO

### DENSITY

#### Residents preferred to live close to urban centres

- + International migrants were accustomed to high density living
- + Young generations had smaller families than their parents so did not require as much space, and enjoyed the buzz of urban life
- ↳ People living in smaller spaces did not want so much clutter

#### ↳ A sharing economy and society steadily grew

- + Technologies made it easier to save or earn money from sharing
- ↳ People no longer felt tied to owning their own homes, vehicles, or tools

### AUTOMATION

#### People grew increasingly wary of fully automated technologies

- + High profile accidents and errors raised concerns about safety and privacy
- + Automation threatened more jobs than it created

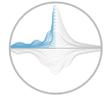
#### ↳ The pace of automation slowed in many sectors

- + Government closely regulated automated technologies due to social pressures
- + Consumers often prefer the human touch, and even pay a premium for it

KEY + Drivers that accelerated this trend ↳ This contributed to other trends

### TRANSITIONS IN TRANSPORT

- > Growing populations of urban residents favoured open public spaces, lively pedestrian streets, and public/shared transport systems in their cities over more roads.
- > Private car users grew increasingly frustrated at rising congestion and parking charges when travelling to and through the city. Shared transport options often seemed like a better alternative than always travelling by private car.
- > Patronage of public/shared transport grew significantly. With increasing density, many people found it easier and cheaper to use buses, light rail, taxis, or ride-shares for short trips instead of private cars.
- > Routes and services became more profitable as patronage grew. Many private operators and entrepreneurs entered the shared transport market to capitalise on these opportunities. They offered a wide variety of services, competing on price and quality.
- > Digital technologies and ubiquitous data sharing via smartphones and personal devices accelerated these trends. Travellers and transport providers could be seamlessly 'matched' in real time. Transport providers increasingly adjusted their routes and timing according to demand.
- > A wide range of car-sharing and ride-sharing services emerged, along with specialised taxi, mini bus, and bus services that offered highly personalised options. Individual car ownership continued to fall as shared services grew.
- > Rail and rapid bus patronage gradually grew on established travel corridors, but most people preferred the flexible routes that ride-sharing and on-demand mini bus services offer.



**In 2045, people travel via a vast variety of different vehicles, operated by many public, private, and community providers.**

---

## **CARS AND LIGHT VEHICLES**

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Car 'usership' [sharing cars and rides] is more popular than ownership, because cars are costly to own, park, and drive [especially at peak periods].

---

Individual car ownership is most common among richer residents and tradespeople.

---

Most cars have automated functions, but require a human driver.

---

Community car-share and longer-term car rental schemes are popular. Cars are often booked to capacity on holidays and weekends, and are more expensive at these times.

---

Commercial and community ride-share vehicles can easily be summoned on demand, and often cluster around rail and bus stations.

---

---

## **HEAVY/LIGHT RAIL**

---

Driver-assisted trains travel on high capacity routes between the city centre and its edges.

---

Trains run fairly frequently when the demand warrants it and follow a set schedule.

---

---

## **BUSES**

---

Large driver-assisted buses run on high capacity fixed routes. Drivers perform the role of 'stewards' who care for passengers and can take control of vehicles when need be.

---

Mini buses, which come in many different sizes, are prolific. They are operated by diverse providers who offer standard and premium services [with greater comfort and space].

---

People can pre-book a mini bus, or simply wave one down on the street and pay more or less depending on the on-board experiences offered.

---

Mini buses sometimes move people to and from rail and bus stations, but more often focus on providing point-to-point services.

---

---

## **WALKING AND CYCLING**

---

Walking and cycling are common because it is easy to get around compact cities and town centres, with many destinations easily reached without needing a motorised vehicle.

---

Bike-share and scooter-share schemes are popular. Bikes and scooters can effortlessly be picked up and dropped off by swiping personal identifiers or credit chips.

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---

## **OTHER**

---

Manually piloted ferries operate on set routes, to fixed schedules.

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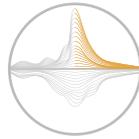
Air taxis are only permitted to be used in some areas, in designated air corridors.

---

Motorbikes are popular among people who prefer to travel independently.

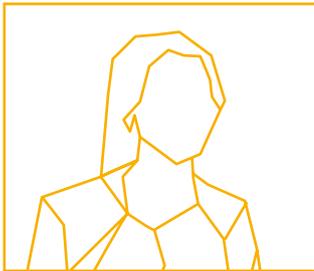
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# CONNECTED CORRIDORS SCENARIO 2045



AUTOMATION: ●●●●● Full DENSITY: **HIGH**

SOCIAL MOOD: **Buzzing** **Perceptive** **Obedient**



Observations on city life by  
**MARAMA LEE**

**Occupation:**

Synthetic Lifeforms Empathy Engineer

**Age:**

41 [born 2004]

## CITY LIFE

“Our city hums with pure energy. It’s smart and super sensory. The best place to get a feel for the city is from above: in a cafe on top of a high rise. As you recharge and recalibrate your body’s sensors you can stretch your vision all the way to the horizon. Your shoulders will soften and your wellness rating will soar as you admire the sunlight reflecting on glistening buildings, the patchwork of green parks and rooftops, and vehicles flowing like powerful rivers on the road and rail corridors below.

If that seems too distant and impersonal, just activate a feed from a camera. You can zoom in on anything interesting, like who’s wearing the latest tech; the newest public sculptures [refashioned and reprinted daily]; and delivery droids scuttling into apartments. You can activate these feeds anywhere, of course, but they’re much more fun to watch when you’re peering down on everything.

When you descend back down to Earth, it’s a joy to move through the city. Just press your ear stud [or wherever you wear your smart-patch] to activate CityZen’s Transport Ambassador. Voice in your desired service or destination and you’ll instantly be given two options: *summon* or *roam*. If you’d prefer to be picked up where you are, for a small premium you can summon a CityZen AutoTaxi.

If you’re happy to roam, you’ll be guided to your destination and get live updates on your arrival time.

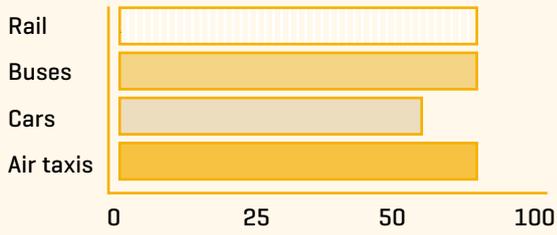
For short trips, you’ll probably walk. For slightly longer trips you’ll be guided to the nearest bus stop or Metro. You’ll never wait long for a CityZen bus or train. If it’s a long trip, such as to the outer suburbs, you’ll probably switch between different services, but the interchanges are quick and easy.

The Transport Ambassador isn’t just a tool. It’s a traveller’s best friend. Let the Ambassador plan your trip, relax, and go with the flow. It knows what you like. You can change your default activity settings [cardio or comfort], privacy preferences [single or shared cabin], and budget [regular or premium] anytime. It also knows how agile you are, how quickly you walk, your current health status, and how you respond to showers or sunshine.

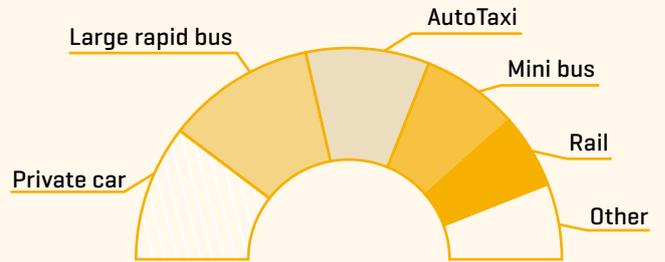
We’re lucky to live in our smart city. We know it well, and our city knows us. We’re finely tuned to each other. We can’t imagine living anywhere else, where we’d only be a stranger. Life would be clunky and lonely without all our accumulated interactions and aggregated responses to experiences. Our travel preferences can obviously travel with us, anywhere in the world. But there’s no place like home and its deep residues of data.”

# OVERVIEW

**Fully automated vehicles [% of fleet]**



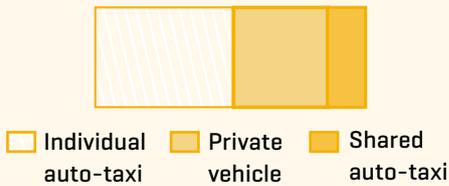
**Total travel in cities (annual km by vehicles)**



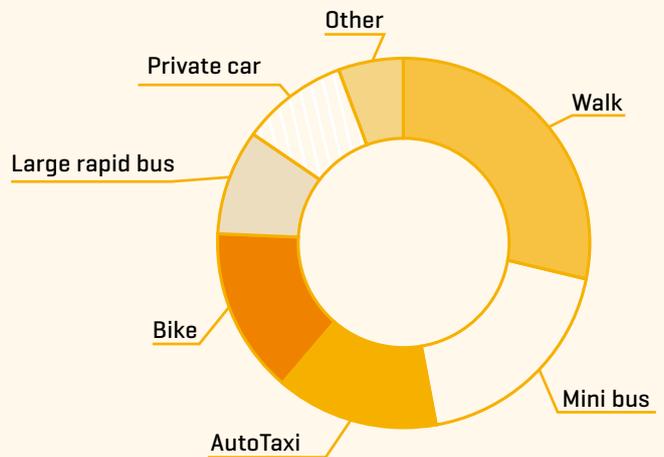
**Household car ownership**



**How people use cars (trips in cities)**



**2km trips: Most common modes**



**Peak travel times: Wednesdays**

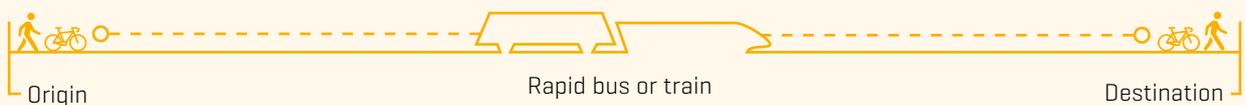


**Routing and scheduling**

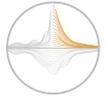


**10km trip into large metropolitan areas:**

Typical shared transport profile at 8am Mondays



NOTE: These are not forecasts. See comments on page 21.



## HOW WE GOT TO THE CONNECTED CORRIDORS SCENARIO

### DENSITY

#### Urban planning favoured much higher urban density

- + Public agencies wanted to avoid expansive infrastructure investments, improve efficiency, and reign in growing greenhouse gas emissions
- ↳ Apartments and townhouses grew more common, clustered around shared transport hubs

#### ↳ Most residents adapted well to denser urban living

- + People valued ease of access, proximity to work and friends, and low travel costs over large suburban houses
- + People accepted living, working and travelling in more confined spaces because technologies gave people a greater *perception* of personal space, while physical spaces grew more crowded

### AUTOMATION

#### Technologies grew smarter at a breathtaking pace

- + As life became busier and louder, people found joy and comfort in new technologies
- + Government and technology companies vigorously encouraged the development of smarter, highly automated cities to boost innovation, growth and security

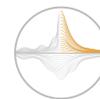
#### ↳ Anything that could be automated has been automated

- + People trust technologies to plan their lives, move them around, keep them safe, and make interventions for their health or security
- + Automation created many new jobs and professions, and outweighed job losses

KEY + Drivers that accelerated this trend    ↳ This contributed to other trends

### TRANSITIONS IN TRANSPORT

- > Growing populations of urban residents living in, or near, the inner city had a strong influence on transport planning. More popular forms of travel (including walking, cycling, buses, and light rail) were given more road space than less popular modes (particularly private cars).
- > The transition to a fully automated transport system was initially led by rapid transit trains and buses, which could easily be automated on dedicated tracks and lanes, separate from other vehicles.
- > The remaining buses, which shared roads with other traffic, were then automated. As buses no longer required human drivers (a major operating cost) it became more economical to boost routes and service frequencies with smaller buses.
- > Automated taxis initially became established in central city areas. Services expanded as technologies improved and public trust in the services grew.
- > Universal monitoring of people using automated trains, buses, and taxis was done for security purposes and often raised privacy concerns, but patronage grew as people felt totally safe using these services.
- > Automated vehicles were well-suited for road pricing. Road users began being charged whenever they travelled, with premium rates during peak periods or in designated locations. Individual car travel grew increasingly expensive.
- > Shared travel modes soared in popularity, as they were cheaper than using a car and usually more convenient.



**In 2045 people mostly travel on automated buses and rail services that run on dedicated corridors, as well as automated taxis. Travellers are automatically assigned to services, based on their travel preferences and service availability.**

## **CARS AND LIGHT VEHICLES**

---

All cars are required to drive autonomously within urban boundaries. This was mandated in 2040 to improve efficiency and safety, and to completely modernise the vehicle fleet.

---

AutoTaxis (autonomous taxis) replaced human taxis and older ride-share and car-share schemes. They are widely available, and cheap to use except at peak periods when road pricing makes solo vehicle travel expensive.

---

All AutoTaxis communicate via a networked 'brain', which co-ordinates different services in response to levels of demand at any given time and place. Travellers interface with this system on their devices through a digital Travel Ambassador.

---

Car 'usership' (sharing cars and rides) is much more popular than ownership, because it is cheaper to summon an AutoTaxi or use shared transport than owning a personal vehicle.

---

Vehicles are owned by a mix of public and private enterprises on a franchising basis.

---

Vehicles with one occupant automatically cede priority to vehicles with shared occupancy, although this can be over-ridden for a fee.

---

## **HEAVY/LIGHT RAIL**

---

Fully automated trains run at very high frequency throughout the day, via high capacity radial corridors.

---

At night, trains run according to the level of demand.

---

## **BUSES**

---

Large automated buses run on high capacity routes in dedicated lanes, connected with rail hubs.

---

Automated mini buses (larger shared versions of AutoTaxis) are common.

---

There are no set timetables or routes. Large buses run very frequently during the day, and are replaced by demand responsive mini buses at night.

---

Travellers are automatically guided to the appropriate bus by their personalised Travel Ambassador, or they can request a mini bus to pick them up for an additional fee.

---

## **WALKING AND CYCLING**

---

It is easy to get around compact cities and town centres.

---

People try to stay healthy by cycling and walking because their lives are highly sedentary.

---

Bike-share schemes are common. Bikes can effortlessly be picked up and dropped off, with users' accounts automatically debited.

---

## **OTHER**

---

Air taxis regularly transport richer citizens living in outer suburbs for trips across town.

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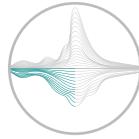
Motorbikes and scooters are popular among people who prefer to travel independently. Steering, stability and speeds are automatically controlled to ensure safety.

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Small automated ferries operate on set routes, and travel according to demand.

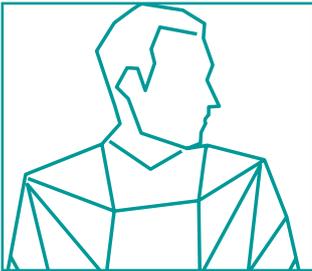
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# MOBILITY MARKET SCENARIO 2045



AUTOMATION: ●●○○○ Partial DENSITY: **LOW**

SOCIAL MOOD: **Spacious** **Self-reliant** **Protective**



Observations on city life by  
**IVOR MCLEOD**

**Occupation:**  
Life Completion Navigator

**Age:**  
88 (born 1957)

## CITY LIFE

“Our city’s got an unbeatable lifestyle. We’ve seen all those pictures of people crammed into cities, like dull-eyed sardines. Compared to them, we’ve got an ocean to play in.

Life’s tops here in summer. We dust off the deck chairs, fire up the barbie, and enjoy a wine with the neighbours while we watch the tomatoes turning pink on the vines. Kids these days are less blemished by sunshine. They’re usually inside, glued to their holoscreens. But they still can’t resist running back and forth through the rainbows when the sprinklers are on. It’s hard to keep pace with all the latest tech and trends, but some things always stay the same.

Anything you need is easy to get to. Just pop in your car or summon a ride-share. The supermarket’s only a few minutes drive, and it’s not much further to the mall. It’s a shame that so many friends and family live on the other side of town, but it’s not so far on the motorways.

I’ve lived in this city all my life, but sometimes I barely recognise it. Back in the 1960s, when I was just a lad, we didn’t move around so much. Your community was the people who lived in your street. Cars were big and handsome then, and most families were lucky to own one. You had to change gears yourself, with a thing called a clutch. Now look at us: almost every home has at least one car, and the cars would fully drive themselves if they were allowed to.

Buses were different too. We often had to wait ages in the rain for these big clunkers to arrive, and never knew when they’d turn up. There was none of this tapping ‘pick up’ on your touch-screen for a mini bus or shuttle.

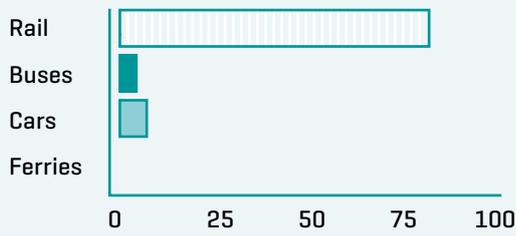
It’s easy to be nostalgic, but it used to be a lot tougher getting around. I like all the options we have nowadays. The latest mobility packages are great. I can choose how many trips or kilometres to pre-pay for a month by car, bus, train, or whatever takes my fancy. Some people pay as they go, but I max out for unlimited off-peak travel. There are plenty of add-ons too, like rental cars, bikes, and mobility scooters. The hard thing is choosing from all the different packages and providers. Lucky I’m still working so I get concessions. Plus I get credits when I ride-share in my own vehicle.

Most of us don’t go into the city much, unless you happen to work there. The motorways are great, but get pricey to use at peak times. At least you can always pre-book a fast lane. There’s also the rapid buses or trains if you live near a line. They travel often enough, but sometimes feel too crowded for my liking. More cans of sardines.

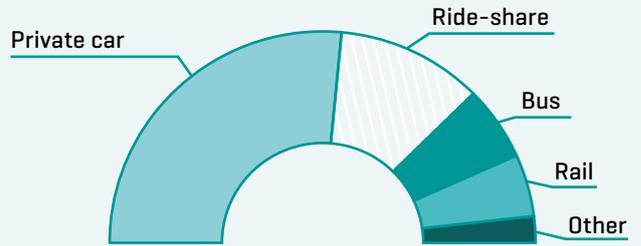
Life in the ‘burbs is sweet, but isn’t for everyone. Some people like living in the city, especially students and professionals without kids. If you don’t mind being boxed in it’s not a bad life. There’s a pretty good buzz, with all the food salons and bars. But you can get that bustle anywhere in the world, right? What’s special about our city is that there’s so much space to stretch out. It really sets us apart.”

# OVERVIEW

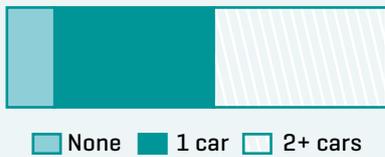
Fully automated vehicles (% of fleet)



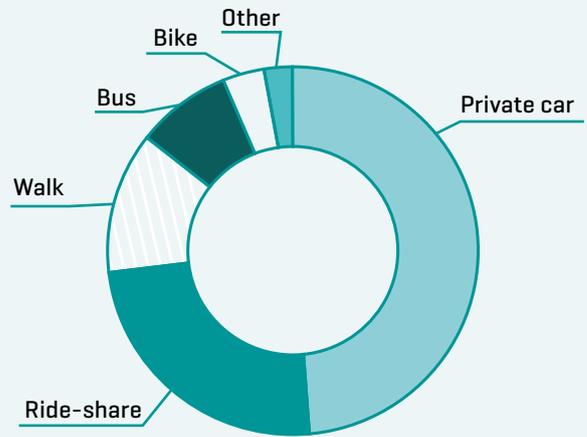
Total travel in cities (annual km by vehicles)



Household car ownership



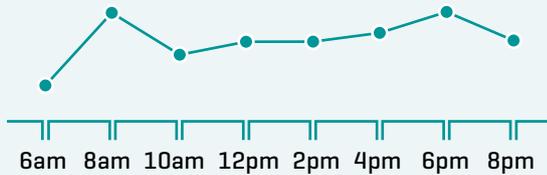
2km trips: Most common modes



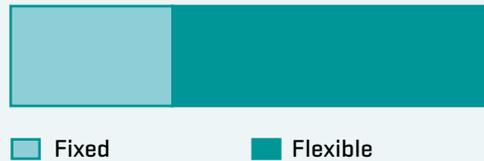
How people use cars (trips in cities)



Peak travel times: Wednesdays



Routing and scheduling



10km trip into large metropolitan areas:

Typical shared transport profile at 8am Mondays



NOTE: These are not forecasts. See comments on page 21.



## HOW WE GOT TO THE MOBILITY MARKET SCENARIO

### DENSITY

#### Housing affordability became increasingly challenging

- + Property prices increased faster than incomes
- ↳ Urban boundaries were constantly extended
- ↳ Low cost high density housing expanded in metropolitan centres



#### People moved further away from metropolitan centres

- + People were prepared to travel more for cheaper houses and greater space
- + Digital technologies made working and learning remotely ever-easier
- + More people wanted to escape the stresses of modern day urban life
- + Houses and apartments in high density areas were not seen as highly desirable

### AUTOMATION

#### The transition to a more automated society has been volatile

- + Technologies from competing businesses did not integrate well
- + Technical failures involving fully automated planes, trains, cars, and buildings overseas made people wary of automated everything



#### New Zealanders became increasingly negative towards automation

- + Despite resistance, technologies disrupted many industries and jobs
- ↳ The tax system was redesigned to encourage employment of humans [including manual jobs like drivers]

KEY + Drivers that accelerated this trend ↳ This contributed to other trends

### TRANSITIONS IN TRANSPORT

- > Private cars have continued to play a dominant role in the transport system, due to the great flexibility that they provide.
- > Car drivers from outer suburbs exerted a strong sway on politics and planning by demanding that elected representatives prioritise roading.
- > Ride-sharing grew slowly for many years, but then erupted for several reasons. Many people began selling rides in their vehicles to earn money, and the costs for corporate ride-share operators to employ drivers fell with lower taxes on manual labour. This enabled ride-sharing network operators to operate at a larger and more profitable scale.
- > Government responded to falling revenue [e.g from lower fuel levies as people increasingly switched to electric cars] by reducing expenditure on public transport.
- > Many bus services declined [or were not planned for] in sprawling suburbs, due to limited and falling demand.
- > Ever-growing congestion from more vehicle movements [including both private and ride-share vehicles] has been managed through a mix of road building, demand management, and better shared transport infrastructure, particularly rapid rail and bus services on high capacity routes.
- > Fully autonomous vehicles have not dominated the fleet because people do not trust them and prefer to be in control themselves.



**In 2045 people mostly travel by car, with ride-sharing common, plus trains/buses on high capacity routes. They often purchase mobility packages with prepaid allowances for travelling on various modes.**

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## **CARS AND LIGHT VEHICLES**

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Individual car ownership, leasing, and use is high.

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Vehicles have increasingly automated functions, but fully autonomous private vehicles are rare.

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Congestion needs to be actively managed due to so many vehicles. Transport management initiatives such as high occupancy lanes, pre-bookable fast lanes, and road pricing encourage people to share journeys into the city.

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Ride-sharing is ubiquitous, and has replaced most taxis and bus services. Services are provided by a diverse array of individuals, social enterprises, and businesses.

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## **HEAVY/LIGHT RAIL**

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A minimalist rail network serves high density corridors between suburbs, metropolitan centres, and the airport.

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Trains are largely automated, but still have human monitors and conductors for passenger safety.

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Private operators on several routes have boosted demand by developing retail and residential sites close to railway stations.

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## **BUSES**

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Regular rapid bus services run on high capacity routes not served by trains.

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Suburban bus routes are rare, as people are served by on-demand ride-share cars and shuttles.

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## **WALKING AND CYCLING**

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Walking and cycling are mostly done for recreational purposes, not as a means of travelling to amenities, due to the long distances for accessing destinations or services.

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Shared bikes and mobility scooters are widely available in city centres and suburban hubs.

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## **OTHER**

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Travellers can pre-purchase 'mobility packages' from many different providers. These entitle consumers to many different benefits, across different services.

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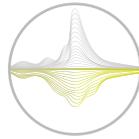
Consumers can personalise packages to suit their needs. For example they can pre-purchase kilometres or time allowances for use on motorways, ride-shares, hire cars, buses, shuttles, trains, or bike-shares.

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Air taxi routes and pick up / drop off locations are tightly regulated, as most residents are highly protective of their privacy and the air space around their homes.

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# PERSONALISED PODS SCENARIO 2045



AUTOMATION: ●●●●● Full DENSITY: **LOW**

SOCIAL MOOD: **Boundless** **Dynamic** **Cocooned**



Observations on city life by  
**LEONARD CHIKO**

**Occupation:**  
Telesurgeon

**Age:**  
24 [born 2021]

## CITY LIFE

“Our city’s deceptive. It seems quiet, but assimilate yourself and you’ll find it’s super-charged. It glows with blazing minds, melded together city-wide and with billions of others globally. Images, ideas, and experiences flow through golden arteries of data. It’s a bright and beautiful node in the great Net that we’re all part of.

Life buzzes behind the walls of homes and bedrooms. Workers chat through screens to colleagues in Sydney, Shenzhen, Seattle, and São Paulo. Students tele-collaborate on projects with their classmates in Takapuna, Taipei, Toronto, and Taupō. Shoppers swipe through 3D images of bio-printable clothes, perfectly tailored to their bio-scanned measurements.

If you could peer behind the tinted windows of any sleek vehicle travelling through town, the picture wouldn’t be radically different. People whirring through streets in the great streams of pods—those vehicles shaped like sleek pea husks—are deeply immersed in the Net. The pods carry us wherever we want or need to go. You can’t beat the convenience of your own comfy cocoon, always available on command.

You can easily choose a pod to suit your journey needs and credit power. The basic system’s the same: select your destination on a private or public touch-screen, confirm the service and price, wait for a pod or go directly to the nearest available vehicle, then swipe your personal sensor to enter. It doesn’t matter who owns the pod, as the shared booking system’s the same.

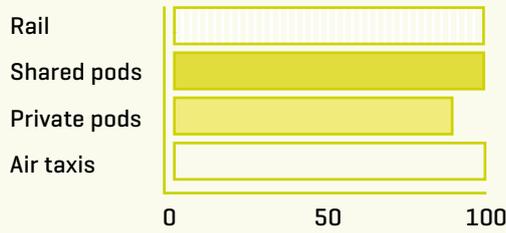
Private pods pick up employees who still work on-site, with plenty of space to start work before being unloaded at the door. Other pods safely carry kids to swimming lessons, tai chi, or kapa haka classes, and entertain them along the way. Shared pods, which come in all shapes and sizes, carry people who can’t afford the greater comfort and convenience of a personal pod to shuttle them around.

The pods are like the blood cells of our great city, safely conveying us wherever we need to go. The Net is our nervous system. The pods and Net gel together like body and mind. They give people great freedom to live, learn, or work where the weather is best, or where the houses are cheapest.

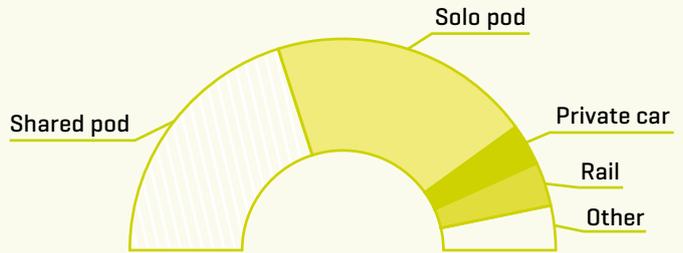
In some ways our city isn’t so different from many other global nodes. That makes it easy to integrate with other people and places. But there’s still something special about living here: the wide open spaces, spotless streets, highly secured neighbourhoods, cultural diversity, pure air, and the easy access to everything else that New Zealand has to offer. It’s our home, and it’s totally boundless.”

# OVERVIEW

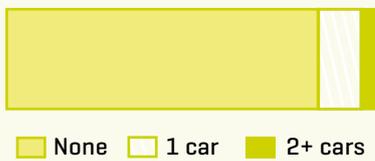
**Fully automated vehicles [% of fleet]**



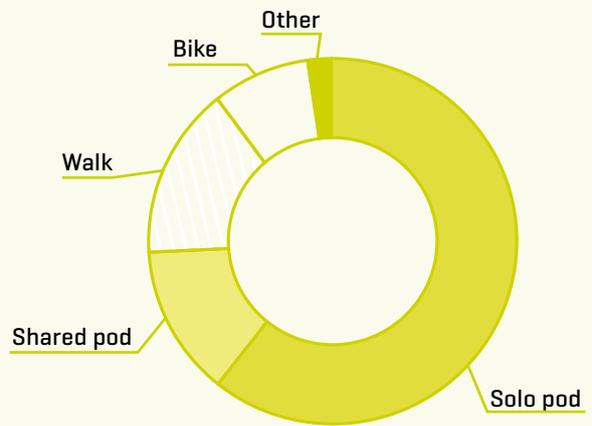
**Total travel in cities [annual km by vehicles]**



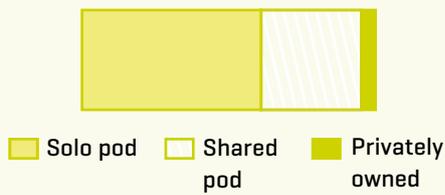
**Household car ownership**



**2km trips: Most common modes**



**How people use cars [trips in cities]**



**Peak travel times: Wednesdays**

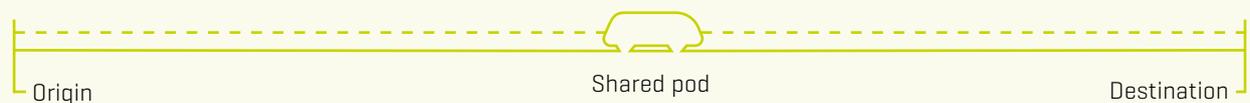


**Routing and scheduling**

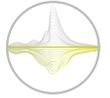


**10km trip into large metropolitan areas:**

Typical shared transport profile at 8am Mondays



NOTE: These are not forecasts. See comments on page 21.



## HOW WE GOT TO

### THE PERSONALISED PODS SCENARIO

## DENSITY

### Cities kept expanding outwards

- + Urban populations kept growing, most residents preferred large homes and plenty of personal space
- Lo Private vehicles offered people the greatest personal mobility, so road building escalated to accommodate more cars travelling

### Lo City centres became less vital places to visit

- + Technologies made it easier to shop, learn, work, connect, and access healthcare remotely
- + People preferred not to spend a lot of time or money travelling for services readily available in suburban centres or via the internet

## AUTOMATION

### Automation accelerated, disrupting many industries

- + New globally connected industries emerged that could be based in any country, city or region
- Lo Many jobs were created and lost, and social divisions grew along technological lines

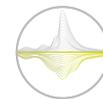
### Lo Technologies reshaped communities

- Lo Many people felt liberated by technologies, while others felt increasingly isolated or alienated

KEY + Drivers that accelerated this trend Lo This contributed to other trends

## TRANSITIONS IN TRANSPORT

- > Technology companies and carmakers increasingly converged, and vigorously marketed autonomous vehicles to boost new car sales and revenue. Automated cars proved popular with consumers due to their quality, safety, reliability, and comfort.
- > The combination of ongoing product innovations (ever-smarter self-driving cars), payment innovations (enabled by GPS and personal tracking), and service innovations (providing mobility on-demand) was a game changer. Fleets of automated cars, known as 'pods', began to service inner city areas. Services soon expanded to outer suburbs.
- > It was more profitable for vehicle technology companies to offer mobility as a service (with customers paying per ride) than to make one-off sales of vehicles or hardware. Shared autonomous vehicles were also much cheaper for travellers to use than owning a vehicle, as the capital and operating costs were spread over many trips (in comparison to privately owned vehicles that were parked for 95 percent of their life).
- > Personal car ownership was disrupted as fleets of driverless pods provided most of the benefits of car ownership (including flexibility, comfort, and cheap travel) for lower cost and stress. When parking, insurance, garage space, maintenance, and fuel costs were considered, individual car ownership became less attractive.
- > Automated vehicles transformed how people travel, as well as the form and dynamics of cities. Self-driving cars enabled people to live ever-further away from city centres, while enjoying effortless travel.
- > As pods became increasingly advanced, widely-available, and cheap to travel in, public patronage of trains and buses plummeted. Many routes were retired due to lack of viability.
- > Automated pods, which range in size from single-seaters to shared vans, are now the dominant form of public/shared transport.



**In 2045 people largely travel via fleets of driverless 'pods', mostly owned and operated by global corporations.**

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## **CARS AND LIGHT VEHICLES**

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Fully autonomous cars and vans ('pods') dominate the vehicle fleet.

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All pods are completely automated. It is illegal for humans to drive a car in cities.

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Pods are mostly owned by corporations that maintain the vehicles and operating systems.

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Travellers can choose to ride in single pods, family/friend pods (2-6 seats), or maxi pods (6+ seats). Most people prefer to travel alone, or with people they trust.

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Ride costs vary according to customer attributes, distance, congestion, and available on-board services.

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Pods can be summoned on demand, or pre-booked.

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Some individuals still prefer to own or lease their own personal pods.

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Pods have replaced taxis, buses, ride-sharing, and car-share schemes.

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## **HEAVY/LIGHT RAIL**

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Rapid rail plays an important role along high capacity routes, in order to reduce congestion.

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All trains are fully automated, with times and speeds automatically calibrated to optimise network efficiency.

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## **BUSES**

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Buses with fixed routes and timetables are obsolete.

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Platoons of shared maxi pods travel on retrofitted bus lanes.

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Travellers can choose different levels of comfort and space (for differentiated rates) in shared pods.

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## **WALKING AND CYCLING**

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Walking and cycling levels are low due to the long distances involved, and the cheap cost of using pods.

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Cycling for short trips is popular and safe. Collision avoidance systems on pods give cyclists plenty of space.

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## **OTHER**

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Fleets of automated ferries operate on demand.

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Parking buildings provide temporary housing for pods during periods of low demand.

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# INSIGHTS FROM THE FUTURES

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New transport technologies and services will open up new possibilities for New Zealanders travelling around our cities in the future. Life could become much more convenient for many urban citizens, with a growing range of travel options to fit travellers' needs, budgets, and preferences. People may be able to choose to travel by rapid transit, self-driving shuttles, cars rented by the minute, shared scooters, biking and walking, or other means, and to combine different transport modes on their journeys.

On the one hand, we could see a shift towards much greater flexibility and variety in shared transport services. Pick up and drop off locations, travel routes, and vehicle features could respond and adapt to people's daily demands. On the other hand, dedicated routes for rapid transit and high capacity vehicles will be crucial to avoid congestion and to create places where people strongly want to live.

This section identifies some important features for urban transport in the future by bringing together insights from the Public Transport 2045 project. It draws on our interviews with public transport experts, research on emerging technologies and trends, and implications that became apparent in the future scenarios.

## THE TRANSPORT SYSTEM IS ENTERING AN ERA OF MORE SHARING

We cannot be sure what New Zealand will be like by 2045, but there are signs that our transport system is on the edge of a major transition. We could be entering a new era—from a transport system based around private cars, to a system of 'shared mobility'.

Three of the four scenarios in this report envisage futures that are remarkably different from today. These are worlds where private car ownership has dramatically fallen because alternatives have developed that people find more attractive. The only scenario where private cars still dominate is 'Mobility Market'. This world is characterised by low urban density and only partially automated vehicles—the scenario that is closest to today.

In the scenarios with higher urban density, and/or higher levels of transport automation, cars still exist. Some are privately owned. But people are able to enjoy many of the benefits that private

vehicles offer without needing to own a car. Car ownership is no longer a widely-held norm. The way that this emerges differs across scenarios.

In 'Shared Shuttles', increasing urban density makes it easier for many people to access work, education, recreation, and friends or family via short trips. It also makes shared services more financially viable, with more people living within service catchment areas. People often travel by walking, cycling, and sharing rides in mini buses or shuttles that are readily available on demand.

In 'Connected Corridors', densely populated urban areas are served by fully automated transport technologies. All vehicles drive autonomously within urban boundaries. Self-driving trains or rapid buses operate on high capacity shared transport corridors, which people can transfer to/from via fleets of self-driving taxis.

In 'Personalised Pods', most people still favour having access to personal cars due to low urban density. They regularly travel across town, and make long commutes in fully automated 'pods'. These vehicles are owned by corporate fleet providers, and are bookable in advance or on demand. Vehicles in these fleets form part of an intelligent network that aims to minimise congestion and journey times.

These scenarios imagine very different urban transport systems, driven largely by the advent of new technologies that are rapidly developing currently. As noted in Section Two, most vehicle manufacturers are competing to commercialise fully autonomous (self-driving) vehicles in the 2020s. It is highly likely that fully autonomous vehicles will operate as shared fleets. This will encourage significantly more vehicle-sharing and ride-sharing, due to the greater convenience and cost advantages compared to private car ownership and use.

Urban density will change more gradually compared to new technologies. We are already seeing more people choosing to live in, or close to, urban centres. Population growth and housing affordability concerns will drive additional housing construction in urban centres in the next few decades, but could also lead to more housing on urban fringes where land is cheaper. We could see multiple scenarios emerging simultaneously, with people living in dense urban environments enjoying access to abundant shared transport options, while those living in low density areas may still rely heavily on private vehicles for much of their travel.

## PUBLIC TRANSPORT WILL BE IMPORTANT IN ANY FUTURE SCENARIO

There will still be a need for public transport in the future. As noted in Section Three, central government supports public transport for the following reasons:

1. to ensure **inclusive access** for those who do not drive or cannot afford their own private motorised vehicle
2. to reduce the **environmental harms** caused by transport
3. to manage **congestion**
4. to improve **urban form and liveability**, and
5. to benefit **health and wellbeing**.

New technologies and services will impact on all of these areas, offering potential benefits and risks.

**Accessibility** is likely to improve in the future if vehicle-sharing, ride-sharing, and Mobility as a Service (MaaS) platforms become common. Shared autonomous vehicles could easily be used by elderly people, young people, and people without a driving licence. These vehicles may be more accessible than current public transport services for people with impairments or disabilities. Travel could also become more affordable if fleets of shared autonomous vehicles become widespread, with mobility costs potentially falling by fifty percent or more in areas served by these fleets.<sup>5</sup> Trains, buses, shuttles, and mini buses could operate more cheaply and more frequently without a human driver. This may create opportunities to reduce fares, redirect subsidies to other services, or improve service levels.

**Environmental harms** from our transport system include local air pollution and greenhouse gas emissions. By 2045, a high proportion of New Zealand's vehicles could be electric-powered. Fleets of shared autonomous electric vehicles could accelerate this transition, as people could enjoy access to modern vehicles without needing to buy one. However, the transition to a fully electric vehicle fleet will take decades. Public transport could make a significant contribution to reducing transport emissions more swiftly if people are attracted to use public transport

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5. For a discussion on how costs could fall, see Deloitte University Press (2016), *Gearing for change: Preparing for transformation in the automotive ecosystem*.

instead of low occupancy vehicles. The transport system also impacts on our environment in other ways, including resource use [e.g. materials and energy for making vehicles], land use [e.g. for roads and parking], and biodiversity. Public transport can contribute to environmental sustainability by reducing the need for both private vehicles and roads.

**Congestion** will be affected by new technologies and services in many ways, depending on how these technologies develop and how people use them. For example, autonomous vehicles could be capable of travelling more smoothly and closely together than vehicles driven by humans today. Greater use of MaaS platforms and ride-sharing could lead to higher average vehicle occupancy. These changes would help to manage congestion, by making better use of infrastructure. However, if people switch from using conventional public transport to using private autonomous vehicles, and/or people continue to use autonomous vehicles in a way that New Zealanders often use cars today [i.e. solo use], then traffic volumes and congestion are likely to increase.

Modelling by the Organisation for Economic Co-operation and Development [OECD] and the International Transport Forum has cautioned that in the absence of high capacity public transport systems, the total distance travelled by cars in cities could roughly double if fleets of shared autonomous vehicles become widespread.<sup>6</sup> This is because these vehicles would need to continuously move between different pick up and drop off locations for different travellers. If autonomous vehicles are more convenient and cheaper than other options, travel movements could increase much more.

Fully autonomous vehicles could also have profound impacts on **urban form and liveability**. Most cars currently sit in car parks or in garages for approximately ninety percent of their working life, taking up space in streets and in buildings, and around businesses, homes, parks, and recreational areas. For example, there are over 2.2 million car parks in the Auckland region, taking up an estimated 35km<sup>2</sup> of land [roughly 225 times the size of Eden Park].<sup>7</sup> Most cars and parking spaces

would be unnecessary if society transitions to fleets of shared self-driving vehicles, without causing any loss of mobility.<sup>8</sup> Car parks could be converted into higher value purposes. For example, car parking spaces on streets could be converted into dedicated rapid transit corridors, bike lanes, and boulevards for walking. Car parking buildings could be converted into apartments, offices, or community spaces.

Although self-driving vehicles offer potential benefits for urban form and liveability, they could also encourage urban sprawl. If travel becomes cheaper [with no parking costs] and more enjoyable [with occupants' attention liberated from driving], many people are likely to opt for cheaper and/or larger houses on urban fringes and accept increasingly longer commutes. Increasing urban sprawl could then adversely affect accessibility and wellbeing, with people needing to travel longer distances/times to access destinations or services. This means that the transition to a highly automated transport system could amplify many undesirable features of our current urban transport systems, such as high traffic volumes and congestion, with associated impacts on urban liveability.

Autonomous vehicles could affect **health and wellbeing** in other ways. Most New Zealanders now walk less than one hour per week beyond their homes or workplaces, and only fifty percent of New Zealand adults are sufficiently active to gain health benefits.<sup>9</sup> If we are heading towards a future where people can easily summon a self-driving vehicle to pick them up and directly drop them at their destinations, then physical activity could fall even further. Public transport could play an increasingly important role in supporting physical and mental wellbeing, if people can safely and enjoyably travel to and from public transport stations/stops by active modes such as walking and cycling.

Putting all this together, it is clear that some forms of public transport and rapid transit will be needed in any future scenario to move large quantities of people safely, swiftly, cleanly, and affordably.

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6. Organisation for Economic Co-operation and Development and the International Transport Forum (2016), *Urban Mobility System Upgrade: How shared self-driving cars could change city traffic*.

7. There are over 900,000 cars in Auckland, and each car has 2-3 car parks allocated to it around homes, businesses, local streets, and shopping centres.

8. Organisation for Economic Co-operation and Development and the International Transport Forum (2016), *Urban Mobility System Upgrade: How shared self-driving cars could change city traffic*.

9. Ministry of Transport (2016), *Transport Outlook Current State 2016*.

# PUBLIC TRANSPORT NEEDS TO EVOLVE TO MAKE A MORE POSITIVE IMPACT

New Zealand's current public transport system will need to adapt over the next couple of decades as new technologies and services evolve. Services will need to become more flexible, more frequent, and more responsive to travellers' needs. The greatest opportunities that we see for public transport to evolve are identified below.

- > **Demand-responsive shuttles could replace many low frequency scheduled bus services and routes.** Transport innovators are already experimenting with ways to use crowd-sourced data to create ever-changing routes, as well as pop up pick up and drop off points. MaaS platforms will make it easier for people to use these services. If self-driving vehicles become common, it will be much cheaper to operate these services without a human driver. This could lead to greater flexibility and frequency of services, boosting convenience and patronage. However some permanent bus stops, or pick up/drop off locations, will still be necessary on popular routes to make it safe, quick, and easy for people to get in and out of vehicles, and to enable efficient traffic flows.
- > **Dedicated rapid transit corridors are an important investment in our future.** Dedicated busways and train lines enable rapid transit services to avoid being delayed by single-occupancy vehicles. This makes journey times quicker, and more reliable, and enables more passengers to travel on the route. Dedicated rapid transit corridors will become increasingly important in the future as our cities grow. The transport options they connect to are more likely to be successful, meaning rapid transit can encourage active and green mobility. We anticipate that fully automated vehicles are likely to make private car travel more convenient and cheaper in the future. This is likely to lead to higher traffic volumes and congestion. Dedicated corridors for moving high volumes of people swiftly, safely, and efficiently, are therefore a form of future-proofing. They will enable us to maintain and improve access and urban liveability as urban populations grow and technologies change. Trains and buses travelling on dedicated rapid transit corridors could also lead the

shift towards fully-automated vehicles. In the future, some high capacity shared transport corridors could potentially be used by a greater variety of vehicles [e.g. convoys of small self-driving high occupancy vehicles].

- > **Vehicle-sharing and ride-sharing services could complement public transport to develop an inter-connected shared mobility system.** In this working paper we have deliberately used the language of 'shared transport' because public transport is part of a larger picture [as discussed in Section Three]. According to a survey by the American Public Transportation Association, people who routinely use shared transport modes like car-sharing, ride-sharing, and bike-sharing are more likely to use conventional public transport.<sup>10</sup> However, there is also evidence that some ride-sharing services have been attracting people away from using public transport.<sup>11</sup> We need to consider ways for different services to complement and support one another. For example, some local government authorities in the United States of America are subsidising people to ride-share short trips to/from rapid transit hubs. They are doing this to encourage greater use of public transport, and because it is cheaper than investing in more roads and inner-city parking buildings.

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10. American Public Transportation Association [2016], *Shared mobility and the Transformation of Public Transit*.

11. Clewlow R, and Mishra G [2017], *Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride-Hailing in the United States*. Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-17-07.

## WE ALSO SEE SOME MAJOR CHALLENGES IN THE TRANSITION AHEAD.

- > **New Zealanders may not embrace a cultural shift towards sharing.** Most New Zealanders are now highly accustomed to doing most of their travel by private car. People are only going to share vehicles and rides if these alternatives are more attractive [e.g. more convenient and cheaper], and if people feel safe and comfortable doing so. Cultural norms will need to develop around ride-sharing in smaller shared vehicles. Vehicle designs will also need to adapt to make sharing more pleasant. People will also need to agree to sharing personal data [which many people have already become accustomed to when using smartphones and social media]. Younger generations may initially be more open than their parents to sharing different vehicles and services, especially if they do not have a driving licence. Although we do not know how New Zealanders will respond to new technologies and services, cultural norms are not static. Cultures shift when people have positive experiences that alter their existing habits and assumptions.
- > **We need to shape technologies, but technologies also have a way of shaping our cities and us.** We only need to look at the history of cars in the twentieth century to see how much technology can transform lives and the places where we live [for both better and worse]. New technologies always offer benefits and risks, and these impacts are never evenly spread. We need to envision what we want our cities to be like, and then try to shape technologies towards this end. The best time to shape a technology is to actively engage with it at the beginning of its development and deployment, rather than managing the effects after it becomes widespread.

As emphasised throughout this working paper, the new technology that will have the greatest impact on our transport system in coming decades is fully autonomous vehicles. These vehicles offer many benefits, particularly for safety and accessibility. They could also play a positive role in transforming cities if they enable us to repurpose car parking buildings and spaces for alternative uses. The risks that we need to anticipate, and plan to avoid now, are that they could also encourage significantly more traffic and urban sprawl, with negative impacts on people's health and our environment.

# GOVERNMENT CAN SHAPE THE TRANSITION TO THE SHARED MOBILITY ERA

There are strong grounds for government to keep supporting public transport in the future. Beyond investing in public transport infrastructure and services, there are three areas where government could intervene in the broader transport system to help shape the transition to the shared mobility era.

Firstly, congestion pricing in our largest cities could be used to encourage people to shift from using private vehicles to public/shared transport at peak travel times. Technologies are already available to enable this, and technological capabilities will grow in the future. For example, fleets of shared autonomous vehicles will automatically track location, distance, and time of travel, which will make payment calculations easy. Crucially, to ensure inclusive access, people need to have ways to share travel (e.g. by public transport and ride-sharing) if they want/need to avoid peak travel costs in a private vehicle. High quality public transport systems could be an important precursor to congestion charging systems if these are introduced in the future.

Secondly, government needs to consider a desirable direction for the development and uptake of autonomous vehicles in New Zealand. Some countries, such as Norway, are deliberately focusing on the testing and development of shared electric autonomous vehicles, rather than just vehicles for individual ownership/use. New Zealand could take a similar approach to guide the development of these technologies in ways that support safety, accessibility, urban liveability, and wellbeing while reducing greenhouse gas emissions.

Thirdly, our regulatory models for public transport will need to adapt to take advantage of new technologies and business models. For example, our current Public Transport Operating Model (PTOM) is based on awarding long-term contracts (e.g. six, nine, or 12 years) to private operators to run services on fixed routes and schedules. Many councils have signed contracts with operators since 2015, so these contracts will run until the early-to-mid 2020s. Local government agencies signing contracts now are also committing to services until the late 2020s. We expect Mobility as a Service platforms, ride-sharing, and vehicle-sharing to become much more common in the 2020s. Vehicles will also become increasingly autonomous. Although we have not specifically evaluated the potential implication of these technologies and services on PTOM, the Ministry of Transport may consider this in a future review of PTOM.

On a final note, we began this working paper by questioning how public transport could be disrupted by emerging technologies and services, and what role it could play in New Zealand's future. One of the key messages from this report is that autonomous vehicles and ride-sharing will not displace the need for public transport. Our conclusion is that public transport will become even more important—if it evolves and adapts. New technologies such as fleets of shared autonomous vehicles do not signify the end for public transport. They could be part of a new chapter in the story of shared mobility.

## APPENDIX: ADDITIONAL NOTES ON THE SCENARIOS

### How these scenarios relate to other transport scenarios

The Ministry of Transport regularly uses scenarios to enable people to think and plan for different futures. Recent projects with scenarios include:

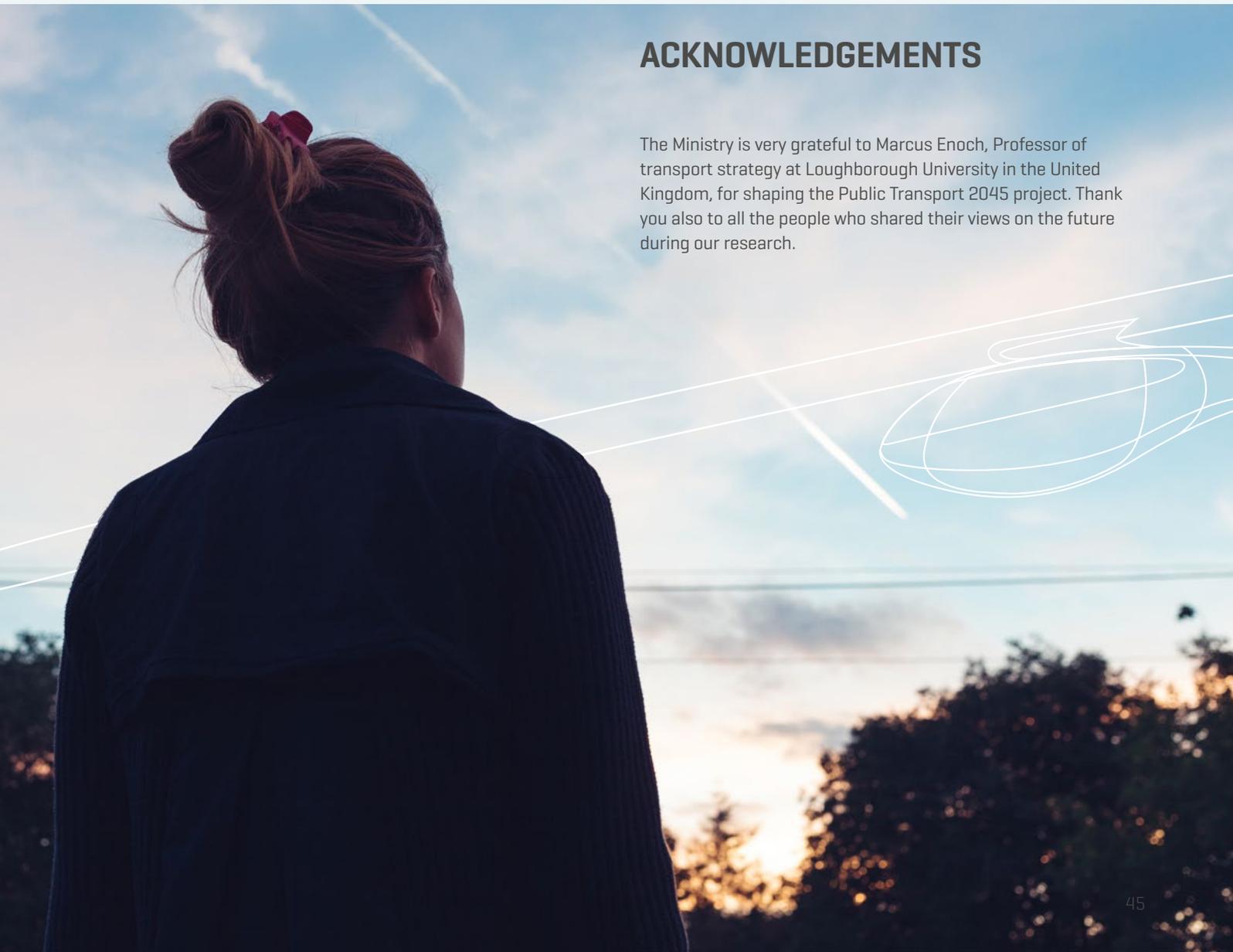
- > *Future Demand (2014)*—exploring the uncertainties of demand for personal travel
- > *Regulation 2025 (2016)*—exploring potential impacts of technology on transport, and society’s willingness to adopt new technologies
- > *Transport Outlook (2017)*—including alternative public transport scenarios.

The scenarios in this document have drawn on insights developed in previous Ministry projects, and have shaped additional work, including the Transport Outlook.

These scenarios are also unique. They explore the influence of different drivers of change, and were developed using distinct methodologies. For example, the scenarios in the Transport Outlook are based on quantitative modelling. The Public Transport 2045 scenarios in this document are based on narratives. They include emerging technologies and systems that are in the early phases of development, with great uncertainty about their uptake, so no data is available on their impact.

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